Report from the Airplane Performance Harmonization Working Group

Issue: Bank Angles for Takeoff

Rule Section: FAR 121.189, FAR 135.379/JAR-OPS 1.495

1 - What is underlying safety issue to be addressed by the FAR/JAR? [Explain the underlying safety rationale for the requirement. Why should the requirement exist? What prompted this rulemaking activity (e.g., new technology, service history, etc.)?]

Currently Part 121 and Part 135 FAR's assume the airplane is not banked before reaching a height of 50 feet, and thereafter, the maximum bank is not more than 15 degrees. Obstacle clearance at certain airports can be improved by the use of bank angles greater than 15 degrees. At present, an operator can request the use of greater bank angles per the requirements in FAR 121.173(f) or 135.363(h). This process may entail providing substantiation of an acceptable level of stall margin protection at the greater bank angles to justify it. Authorization for the greater bank angle will be provided through the Operations Specification.

Currently, JAR-OPS 1 describes the conditions when bank angles greater than 15 degrees can be used. This includes having adequate allowances for the effect of bank angle on operating speeds.

The Performance Harmonization Working Group (PHWG) task is to identify differences in the FAR/JAR rules and recommend changes which will lead to harmonization of the two sets of rules.

2 - What are the current FAR and JAR standards relative to this subject? [Reproduce the FAR and JAR rules text as indicated below.]

Current FAR text:

Part 121

FAR 121.189 Transport category airplanes: Turbine engine powered; takeoff limitations.

(f) For the purposes of this section, it is assumed that the airplane is not banked before reaching a height of 50 feet, as shown by the takeoff path or net takeoff flight path data (as appropriate) in the Airplane Flight Manual, and thereafter that the maximum bank is not more than 15 degrees.

Part 135

FAR 135.379 Large transport category airplanes: Turbine engine powered: Takeoff limitations.

(f) For the purposes of this section, it is assumed that the airplane is not banked before reaching a height of 50 feet, as shown by the takeoff path or net takeoff flight path data (as appropriate) in the Airplane Flight Manual, and after that the maximum bank is not more than 15 degrees.

Current JAR text:

JAR-OPS 1.495 Take-off Obstacle Clearance

(c) When showing compliance with subparagraph(a) above:

(1) Track changes shall not be allowed up to the point at which the net take-off flight path has achieved a height equal to one half the wingspan but not less than 50 ft above the elevation of the end of the take-off run available. Thereafter, up to a height of 400 ft it is assumed that the aeroplane is banked by no more than 15 degrees. Above 400 ft height bank angles greater than 15 degrees, but not more than 25 degrees may be scheduled.

(3) An operator must use special procedures subject to the approval of the Authority, to apply increased bank angles of not more than 20 degrees between 200 ft and 400 ft, or not more than 30 degrees above 400 ft (See Appendix 1 to JAR-OPS 1.495(c)(3)).

(4) Adequate allowance must be made for the effect of bank angle on operating speeds and flight path including the distance increments resulting from increased operating speeds. (See AMC OPS 1.495(c)(4)).

2a – If no FAR or JAR standard exists, what means have been used to ensure this safety issue is addressed? [Reproduce text from issue papers, special conditions, policy, certification action items, etc., that have been used relative to this issue]

N/A

3 - What are the differences in the FAA and JAA standards or policy and what do these differences result in? [Explain the differences in the standards or policy, and what these differences result in relative to (as applicable) design features/capability, safety margins, cost, stringency, etc.]

Both the FAA and JAA operating rules stipulate when to start the bank and what the basic bank angle shall be. The differences are that the JAA rule allows the use of bank

angles greater than the basic value and it identifies added requirements for the use of the increased bank angles.

The current Part 121/135 rules state the airplane is not banked before reaching 50 feet and thereafter the maximum bank is not more than 15 degrees. The rules do not define acceptable means of using greater bank angles.

JAR-OPS 1 rules state the airplane track is not changed until the net take-off flight path achieves a height equal to one half the wingspan but not less than 50 ft. Thereafter, up to 400ft the airplane is banked by no more than 15 degrees. Above 400 ft bank angles greater than 15 degrees but not more than 25 degrees may be scheduled.

Furthermore, JAR-OPS 1 states the operator may use increased bank angles of not more than 20 degrees between 200 ft and 400ft, or not more than 30 degrees above 400 ft with the approval of the Authority.

The JAR requires that adequate allowance must be made for the effect of bank angle on operating speeds and the increase in distance resulting from increased speeds. The FAR has no corresponding requirement.

4 - What, if any, are the differences in the current means of compliance? [Provide a brief explanation of any differences in the current compliance criteria or methodology (e.g., issue papers), including any differences in either criteria, methodology, or application that result in a difference in stringency between the standards.]

Some US operators have used bank angles greater than 15 degrees at certain airports to improve obstacle clearance. This was done by obtaining a deviation from the 15 degrees bank requirement per FAR Part 121.173(f) or 135.363(h). This is usually accompanied by substantiation that the acceptable stall margin is maintained at the higher bank angle. The deviation authorization was shown as a special airport procedure in the operations specification.

When comparing the rules it seems the current FAR is more stringent because it requires authorization for any bank angle greater than 15 degrees. The JAR allows certain bank angles greater than 15 degrees above 400 ft. without first getting special authorization.

5 – What is the proposed action? [Describe the new proposed requirement, or the proposed change to the existing requirement, as applicable. Is the proposed action to introduce a new standard, or to take some other action? Explain what action is being proposed (not the regulatory text, but the underlying rationale) and why that direction was chosen for each proposed action.]

A description of how to utilize bank angles greater than 15 degrees has previously been described in the draft AC 120-XXX . This AC was developed to explain acceptable

methods for airport obstacle analysis to comply with the intent of FAR's 121.189 and 135.379. The U.S. operators on the PHWG felt the bank angle discussion in the AC was a good basis for harmonizing the FAR and JAR.

The basic premise for the changes to the FAR and JAR would be to allow certain bank angles greater than 15 degrees without requiring special prior approval from the regulatory authority as long as appropriate methods are used to account for the effects of bank angle. It should be possible to use even greater bank angles with special approval from the regulatory authority..

The proposed change to 121.189(f)/135.379(f), renumbered as 121.189(h)/135.379(h), would allow bank angles up to 15 degrees below 100 feet, up to 20 degrees between 100 feet and 400 feet, and up to 25 degrees above 400 feet if approved methods are used to account for the effects of increased bank angle. Draft AC 120-XXX, as updated by the Working Group, would provide an approved method as referenced in the proposed 121.189(h)/135.379(h). Larger bank angles could only be used if approved by the Administrator.

JAR-OPS 1.495(c)(1) would be revised to match the proposed FAR text.

The following is a brief summary of some of the relevant discussions that took place over the history of the PHWG meetings.

There was technical consensus that turns should not be initiated below 50 ft. or one-half the airplane's wingspan, whichever is higher. Then for turns below 400 feet, one operator indicated they have at least one turn procedure where a bank in excess of 15 degrees is initiated below 400 feet. The U.S. operators took an action item to survey ATA members for existing procedures that would be affected by the JAA limitations. In general, the U.S. operators welcomed the increased bank angle capability offered by JAR-OPS, but were concerned the altitude limits could impact existing procedures. The FAA indicated there is concern in the pilot community and within the FAA, Operations discipline, with operating at bank angles in excess of 15 degrees early in the takeoff maneuver (below 400 ft.).

Results were reported from a survey of ATA members on questions about rule changes related to bank angle. Several airlines reported on revenue loss and possible loss of operations if not able to use 20 degrees bank at a height of 100 ft. at St. Maarten. On the issue of acceptable minimum altitude for the initiation of turns with 20 degrees of bank, the majority voted for 100 ft. or one-half the airplane's wingspan, whichever was greater.

After lengthy discussions on the different bank angles and turning heights in the JAR and AC text it was proposed to change the JAR-OPS text to read: "……increased bank angles of not more than 20 degrees between <u>100 ft or half the wingspan whichever is greater</u> and 400 ft,…..etc." and draft a new FAR requirement or expand FAR 121.189(f).

JAA indicated that the PERF SC has discussed the proposal for increased bank angles. They could accept 20 degrees banked turns as low as 100 ft, but would require the data to be “contained in the AFM”.

The draft harmonization document was reviewed. It was reported that FAR 121.189 new (h) has been adapted to provide the use of higher bank angles after reaching a specified height. It states that approved methods are to be used to account for the effects of bank angle. These approved methods will have to be put into advisory material. For higher bank angles than specified, a special approval by the Administrator is necessary. Furthermore approval by the Administrator is only applicable for bank angles of more than 20 degrees between 100 and 400 ft and more than 25 degrees above 400 ft whereas the JAR requires approval for even the lower bank angles. JAA PERFSC to look at possibility of harmonizing with FAR wording.

With regard to bank angles, the JAA stated the PERFSC agreed to harmonize with the proposed FAR with respect to increased bank angles and the associated limiting heights. ALPA expressed concern that the start-of-turn altitudes permitted by the proposed rule are too low.

ALPA recounted a discussion from the 11th PHWG meeting concerning a potential mismatch between airline FOMs and special procedures. An ALPA survey of several airlines indicated most advise flight crews not to begin turns below 400 ft. and to limit bank angles to 15 degrees. None of the respondents train crews to begin turns at 50 ft. Overall conclusion of the ALPA survey was there is indeed a mismatch between the operators’ FOMs and their special procedures. One operator’s response to ALPA’s conclusions stated engine failures are special cases and may require special takeoff procedures at some airports(e.g. 121.445 airports) which may not be found in FOM normal procedures. A specific description of the special procedure is provided on a special page for that airport and if necessary, due to differences from normal procedures, training may be provided for that specific runway. In other words, looking at the general procedures in a FOM will not show where special procedures or possibly special training may be required for a specific runway. These concerns were addressed by revising the draft AC 120-XXX to involve pilots in the planning process for the development of such procedures.

For each proposed change from the existing standard, answer the following questions:

6 - What should the harmonized standard be? [Insert the proposed text of the harmonized standard here]

Proposed FAR text:

Part 121

FAR 121.189 Transport category airplanes: Turbine engine powered; takeoff limitations.

(h) For the purposes of this section, the airplane shall not be banked before reaching a height equal to one half the wingspan, but not less than 50 feet, as shown by the takeoff path or net takeoff flight path (as appropriate) in the Airplane Flight Manual. Thereafter bank angles up to 15 degrees below 100 feet, up to 20 degrees between 100 feet and 400 feet, and up to 25 degrees above 400 feet may be used if approved methods are used to account for the effects of bank angle. Larger bank angles may not be used unless approved by the Administrator.

Part 135

FAR 135.379 Large transport category airplanes: Turbine engine powered: Takeoff limitations.

(h) For the purposes of this section, the airplane shall not be banked before reaching a height equal to one half the wingspan, but not less than 50 feet, as shown by the takeoff path or net takeoff flight path (as appropriate) in the Airplane Flight Manual. Thereafter bank angles up to 15 degrees below 100 feet, up to 20 degrees between 100 feet and 400 feet, and up to 25 degrees above 400 feet may be used if approved methods are used to account for the effects of bank angle. Larger bank angles may not be used unless approved by the Administrator

Proposed JAR text:

JAR-OPS 1.495 Take-off Obstacle Clearance

(c) When showing compliance with subparagraph (a) above:

(1) Track changes shall not be allowed up to the point at which the net take-off flight path has achieved a height equal to one half the wingspan but not less than 50 ft above the elevation of the end of the take-off run available. Thereafter, up to a height of 400 ft it is assumed that the aeroplane is banked by no more than 15 degrees. Above 400 ft height bank angles greater than 15 degrees, but not more than 25 degrees may be scheduled.

(3) An operator must use special procedures subject to the approval of the Authority, to apply increased bank angles of not more than 20 degrees between 100 ft and 400 ft, or not more than 30 degrees above 400 ft (See Appendix 1 to JAR-OPS 1.495(c)(3)).

(4) Adequate allowance must be made for the effect of bank angle on operating speeds

and flight path including the distance increments resulting from increased operating speeds. (See AMC OPS 1.495(c)(4)).

7 - How does this proposed standard address the underlying safety issue (identified under #1)? (Explain how the proposed standard ensures that the underlying safety issue is taken care of).

Obstacle clearance can be improved by using bank angles greater than 15 degrees. This requires having an acceptable level of stall margin protection at the greater bank angles and accountability of the effect of bank angle on operating speeds. The bank angle increase is limited to 20 degrees between 100 ft. and 400 ft., and up to 25 degrees above 400 ft.

8 - Relative to the current FAR, does the proposed standard increase, decrease, or maintain the same level of safety? Explain. [Explain how each element of the proposed change to the standards affects the level of safety relative to the current FAR. It is possible that some portions of the proposal may reduce the level of safety even though the proposal as a whole may increase the level of safety.]

The proposed standard would maintain the level of safety but would provide a standardized method of accounting for banked turns above 15 degrees which would allow a greater change to an airplane flight path to better avoid significant obstacles. Also the proposed standard specifically identifies the combination of bank angles (greater than 15) and heights that can be used when approved methods are employed to account for the effects of bank angle. Previously the operator could request greater bank angles as a deviation per the requirements in FAR 121.173(f) or 135.363(h) but there were no bank angle/height limits specified or performance substantiation required.

9 - Relative to current industry practice, does the proposed standard increase, decrease, or maintain the same level of safety? Explain. [Since industry practice may be different than what is required by the FAR (e.g., general industry practice may be more restrictive), explain how each element of the proposed change to the standards affects the level of safety relative to current industry practice. Explain whether current industry practice is in compliance with the proposed standard.]

Relative to industry practice, the proposed standard would increase the level of safety for those operators now using bank angles greater than 15 degrees by identifying the combination of bank angles and heights that can be used. This is based on the use of approved methods to account for the effects of increased bank angle. For those operators using only 15 degrees bank turns today it will provide an improved option for avoiding significant obstacles in the future.

10 - What other options have been considered and why were they not selected? [Explain what other options were considered, and why they were not selected (e.g., cost/benefit, unacceptable decrease in the level of safety, lack of consensus, etc.) Include the pros and cons associated with each alternative.]

An alternative would be to leave the FAR as it is today. This would require operators to continue to request deviations for the use of bank angles greater than 15 degrees and the current FAR standard would not be harmonized with the JAR. It was not acceptable to the JAA to remove the capability to use increased bank angles from their standard. Not harmonizing the two standards could result in an economic disadvantage for FAA operators if they are limited to using special procedures based on using 15 degrees or less of bank. The present FAA draft AC 120-XXX explains the usage of bank angles greater than 15 degrees so the best alternative seemed to be to harmonize the FAR and JAR standards.

11 - Who would be affected by the proposed change? [Identify the parties that would be materially affected by the rule change – airplane manufacturers, airplane operators, etc.]

Both operators and manufacturers would be affected by the proposed change. Operators would be able to use bank angles greater than 15 degrees in special takeoff procedures without first requesting a regulatory deviation. For some operators not previously using larger bank angles this could result in a flight path that avoids an obstacle laterally instead of clearing it vertically with the possible result of a payload increase. Manufacturers would be requested by operators to provide performance data consistent with “approved methods” to account for the effects of increased bank angle.

12 - To ensure harmonization, what current advisory material (e.g., ACJ, AMJ, AC, policy letters) needs to be included in the rule text or preamble? [Does any existing advisory material include substantive requirements that should be contained in the regulation? This may occur because the regulation itself is vague, or if the advisory material is interpreted as providing the only acceptable means of compliance.]

N/A.

13 - Is existing FAA advisory material adequate? If not, what advisory material should be adopted? [Indicate whether the existing advisory material (if any) is adequate. If the current advisory material is not adequate, indicate whether the existing material should be revised, or new material provided. Also, either insert the text of the proposed advisory material here, or summarize the information it will contain, and indicate what form it will be in (e.g., Advisory Circular, policy, Order, etc.)]

There is currently no existing advisory material. The FAA draft AC 120-XXX, which has existed since 1992, has been updated as a result of the harmonization effort and is adequate advisory material. The AC, at present, addresses the existing FAR standard. This portion of the AC will be revised in the future after the FAR standard is revised. This revision will replace the requirement to get an Operations Specification authorization with the wording contained in the revised standard for the use of bank angles greater than 15 degrees at specific heights. The Working Group recommends that the draft AC be approved and published as soon as possible, without waiting for the proposed rule changes.

14 - How does the proposed standard compare to the current ICAO standard? [Indicate whether the proposed standard complies with or does not comply with the applicable ICAO standards (if any)]

ICAO Annex 6 Attachment C provides examples to illustrate the performance requirements for various airplane categories as intended by the provisions of Chapter 5. Under 3. "Take-off obstacle clearance limitations," it states,.....In determining the allowable deviation of the net take-off flight path in order to avoid obstacles by at least the distance specified, it is assumed that the aeroplane is not banked before the clearance of the net take-off flight path above obstacles is at least 15.2m (50 ft.) and that the bank thereafter does not exceed 15 degrees. The ICAO standard is comparable to the current FAR standard. Neither one explicitly addresses bank angles greater than 15 degrees. (Do not know if ICAO has a provision for requesting deviations.)

15. – Does the proposed standard affect other HWG's? [Indicate whether the proposed standard should be reviewed by other harmonization working groups and why.]

No.

16 - What is the cost impact of complying with the proposed standard? [Please provide information that will assist in estimating the change in cost (either positive or negative) of the proposed rule. For example, if new tests or designs are required, what is known with respect to the testing or engineering costs? If new equipment is required, what can be reported relative to purchase, installation, and maintenance costs? In contrast, if the proposed rule relieves industry of testing or other costs, please provide any known estimate of costs.]

Manufacturers may have a small cost increase for doing an engineering analysis to develop the performance adjustments to account for the effects of bank angles greater than 15 degrees. Operators also may have a small cost increase for developing special takeoff procedures based on bank angles greater than 15 degrees and evaluating the performance adjustments to account for the effects of the greater bank angles. This should be offset significantly by the benefit of possible payload increase for a special procedure based on a bank angle greater than 15 when compared to a procedure using a bank angle of 15 degrees.

17 - If advisory or interpretive material is to be submitted, document the advisory or interpretive guidelines. If disagreement exists, document the disagreement.

Draft AC 120-XXX is being submitted as part of the ARAC Performance Harmonization process. It has not been harmonized with the JAR standards because the obstacle analysis splay and the missed approach analysis is not accepted by the JAA. The contents of the AC have been reviewed and revised by the Working Group and judged to provide adequate advisory material for the existing FAR standards. When the FAR standards are revised the AC will be revised where necessary. In the meantime it is recommended the draft AC be implemented as soon as possible.

18. – Does the HWG wish to answer any supplementary questions specific to this project? (If the HWG can think of customized questions or concerns relevant to this project, please present the questions and the HWG answers and comments here.)

The Working Group is concerned that the revised standards could be used as a justification for allowing the construction of obstacles in close proximity to airports. The revised standards would make it easier for an operator to develop special obstacle avoidance procedures utilizing low altitude turns and increased bank angles. The FAA should not consider this capability when deciding whether or not to approve construction of obstacles near airports. Likewise, applicants should not be permitted to use this capability as an argument supporting such construction.

19. – Does the HWG want to review the draft NPRM prior to publication in the Federal Register?

Yes.